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ECONOMIC INTELLIGENCE REPORT

COKING COALS IN THE USSR

CIA/RR 65
28 November 1955

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

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CIA/RR 65

(ORR Project 26.474)

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COKING COALS IN THE USSR*

Summary

The continued development of the industrial economy of the USSR is dependent, in large measure, on the availability of coking coals. Coking coals are the raw materials from which high-temperature coke is produced, and high-temperature coke is an essential component in the production of pig iron. An adequate supply of pig iron, in turn, is essential to the production of iron and steel, which is basic in any major industrial economy.

The expansion of the heavy-industry sectors of the Soviet economy has resulted in rapidly growing demands for coking coals, and the production of coking coals is given high priority in Soviet planning. The Fifth Five Year Plan (1951-55) provided for an increase in the production of coking coals of not less than 50 percent. This goal is significant when it is considered that the USSR must mine and prepare coking coals under relatively difficult conditions.

The principal deposits and areas of production of coking coals in the USSR are in the Donbas (Donets Basin), the Kuzbas (Kuznets Basin), the Karaganda Basin, and the Kizel Basin. The Donbas and the Kuzbas provide about 90 percent of Soviet coking coals, and although reserves of these coals are adequate for centuries, it is probable that mining capacities in these basins will limit production to levels slightly above current output. The largest expansion has been planned for the Karaganda Basin, which eventually is to supplant the Kuzbas as a major source of coking coals for the Urals area. Extensive reserves of coking coals in the Vorkuta area in the Pechora Basin probably will be developed in the future.

* The estimates and conclusions contained in this report represent the best judgment of ORR as of 1 October 1955.

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The production of coking coals in the USSR is estimated to have been about 55.1 million metric tons* in 1954, about 16 percent of the total Soviet production of coals of all types and grades in 1954. It is estimated that the production of coking coals in 1955 will almost meet the original plan goal of about 64 million tons. The production of coking coals in the USSR is roughly equal to the total supply. Few, if any, coking coals are imported, and only small amounts are exported -- about 318,000 tons in 1954.

About 90 percent of all coking coals consumed in the USSR is used to make high-temperature coke for the ferrous metallurgy industry. The remaining coking coals provide coke for foundries, chemical plants, nonferrous metallurgy plants, and rail and water transportation.

Limitations to the expansion of the coking coal base in the USSR are imposed by shortages of the proper types of coking coals at individual coke plants and the necessity for the mechanical cleaning of most coking coals because of the high content of impurities.

Coking coals of the Donbas and of the Kizel Basin are coked locally, but it is probable that all of the coking coals of the Karaganda Basin are coked in the Urals. From 62 to 63 percent of the coking coals of the Kuzbas are coked in the Urals, and the rest are coked in local plants in the Kuzbas. Transportation costs represent about one-third of the delivered cost to the Urals of the coking coals of the Karaganda Basin and about one-half of that of the coking coals of the Kuzbas. The long rail hauls required for about 26 percent of Soviet coking coals constitute the principal vulnerability of the coking-coal industry of the USSR.

Planned increases in the production of coking coals give no indication of Soviet military intentions. Virtually any steps taken to increase the available supply of coking coals could be attributed to normal efforts to provide a sound raw materials base for the Soviet iron and steel industry.

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* Tonnages are given in metric tons throughout this report.

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I. Introduction.

A. General.

The purpose of this report is to measure the raw-material base for coking coals in the USSR and to determine the possibilities for the expansion of that base. The variety of coals involved and the problems pertinent to their mining, preparation, and coking require consideration of both economic and technological factors. Activities not peculiar to coking coals (mechanization of mines, labor, and so forth), however, are specifically excluded from this report.

This report discusses primarily coals used to make high-temperature coke. Other coals used in the manufacture of medium-temperature coke and low-temperature coke are discussed briefly.*

In the Soviet Fifth Five Year Plan (1951-55), coking coals are listed as one of the strategic raw material bases to be expanded. The Plan provides for the further development of deposits of coking coals and for an increase in production of not less than 50 percent.

The level of development of heavy industry is determined to a large extent by the level of development of the steel industry, which, in turn, depends primarily on the availability of iron ores and coking coals. In the USSR, coking coals of the required quality are not readily available, and deposits are generally at an appreciable distance from the iron ores. The deposits of Donbas coking coals are about 480 kilometers from the iron ore deposits of Krivoy Rog, and coking coals of the Kuzbas and the Karaganda Basin are about 2,000 and 1,200 kilometers, respectively, from the iron ore deposits of the Urals. Because the iron ore and coking-coal deposits are not linked by waterways, about 26 percent of the Soviet supply of coking coals must be transported over great distances by rail at high costs. Furthermore, the average quality of Soviet coking coals is poorer, and extraction is generally more difficult than in most other countries. The UK, Western Europe, and the US have decided advantages over the USSR with respect to the availability, accessibility, and quality of coking coals.

* See Section III, p. 27, below.

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Against these natural obstacles the progress of Soviet industry, particularly the ferrous metallurgical industry, has been impressive. The establishment of a second coking-coal base in the Kuzbas and the conversion of this basin during World War II to the position of principal supplier of coking coals indicate the potential of the USSR to maintain a large raw-material base for these vital coals.

Postwar plans and directives in the USSR provide for exploration for new coal deposits, construction of new mines and preparation plants, and expansion of mining facilities at much higher rates for coking coals than for other coals.

In selecting coals for the manufacture of metallurgical coke, more factors must be considered than for any other major use of coals. At present, no other basic industry requires coal of such high quality and degree of uniformity. The free substitution of other coals or fuels as practiced by energy-consuming sectors is not possible with coking coals.

B. Definition of Terms.

1. Coking Coals.

In this report the term coking coals refers to all types of coals used to make high-temperature coke.* This use of the term follows the general practice of Soviet publications. Although coking coals are usually coals with coking characteristics, small amounts of coals with no coking characteristics are used in some coking-coal blends. Not all coals with coking characteristics are used to make high-temperature coke. Limitations such as excessive impurities and lack of complementary blending coals at certain plants preclude the use of some coals with coking characteristics in the production of high-temperature coke.

* In this report, coals used to produce medium- or low-temperature coke are described merely by type and are not considered to be coking coals.

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2. Types of Coking Coals. 1/*

Coking coals are included in the following types of coals 2/:

Type	Description	Volatile-Matter Content (Percent)
D	Long-flame	More than 42
G	Gas	36 to 44
PZh	Steam, fat	26 to 36
K	Coking	18 to 26
PS	Steam, caking**	12 to 18
T	Lean, noncaking	Less than 17

a. Type K.

Type K is the basic coking coal. In general, it is the only type that can be coked without being mixed with other types, and it is the most desirable ingredient in the average coking-coal blend.

b. Type PZh and Type PS.

Type PZh is a steam coal that is "fatter" (having a higher volatile-matter content) than Type K. Type PS is a steam coal that is "leaner" (having a lower volatile-matter content) than Type K. When mixed in complementary proportions, these two coals are second in demand for coking-coal blends.

50X1

** The term caking in this tabulation is used by the Russians merely to distinguish the strongly caking PS type from the weaker caking PZh type. The G, PZh, K, and PS types are the basic caking coals.

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c. Type G.

Type G is a gas coal that is "fatter" than Type PZh and is being used in increasing amounts in coking blends when sufficient "leaner" coals are available.

d. Type T and Type D.

Type T is the "leanest" bituminous coal. Type D (long-flame) is the "fattest" bituminous coal. Extremely small amounts of these types are used for coking.

3. High-Temperature Coke.

High-temperature coke is coke manufactured at temperatures of 900°C and higher. It is used principally in ferrous metallurgy in blast furnaces and foundry cupolas. Throughout this report the term coke, used without further description, means high-temperature coke. Petroleum coke is not discussed in this report.

4. Medium-Temperature Coke.

Medium-temperature coke is coke manufactured at temperatures of 600°C to 750°C in narrow-chamber ovens. The process yields coal gas, tar with a high phenol content, high-grade motor fuel, and soft coke.

5. Low-Temperature Coke.

Low-temperature coke is coke manufactured at temperatures of 450°C to 550°C. This process is commonly referred to as semicoking. In the USSR the main purpose of semicoking is to obtain process gas and primary tar, which are used in the production of synthetic liquid fuel.

C. Organization.

The production and a part of the preparation of coking coals in the USSR is the responsibility of the Union-Republic Ministry of the Coal Industry of the USSR and the Union-Republic Ministry of the Coal Industry of the Ukrainian SSR. 3/ The Union-Republic Ministry

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of Ferrous Metallurgy of the USSR and the Union-Republic Ministry of Ferrous Metallurgy of the Ukrainian SSR are responsible for the coking of nearly all, and for the preparation of most, of the coking coals. 4/ Production, preparation, and coking of these coals in the Ukraine are presumably under the respective Ukrainian ministries, and in the RSFSR, under the respective Soviet ministries.

II. Coking Coals for High-Temperature Coke.

A. Reserves and Deposits.

The principal reserves and deposits of coking coals in the USSR,* accessible and economically workable at the present time, are in the Donbas (Donets Basin) in the East Ukraine and in Kamensk Oblast, in the Kuzbas (Kuznetsk Basin) in West Siberia, in the Karaganda Basin in Kazakh SSR, and in the Kizel Basin in the Urals. 5/ During 1954 the production of coal for use in coking began in the Tkvarcheli and Tkvibuli fields in the Georgian SSR. 6/ In addition, coals with coking characteristics are known to exist at Pechora, Noril'sk, Irkutsk, Bukachacha, Bureya, and Suchan, and on Sakhalin Island. In fact, there is fairly reliable evidence that coke has been produced from Noril'sk, 7/ Suchan, 8/ and Sakhalin 9/ coals.

Despite relatively large reserves of coals with coking characteristics in these and other basins, many factors prohibit their use for making high-temperature coke.** The more economical mining at or near the surface is generally precluded because coals at these levels have either poor coking characteristics or none. Most deposits of coals with coking characteristics are at levels deeper than those that are being mined currently. Many of these reserves are at depths where mining generally has been considered unfeasible. The necessary mechanization of mining at great depths results in coals with a high content of impurities. Furthermore, for the conservation of all coals, the USSR employs mining methods which retard the production of individual coals or types of coals.

* Customarily in discussions of reserves, the term coals with coking characteristics is used instead of the term coking coals because (1) reserves are measured by type of coal and not by ultimate usage and because (2) the term coking coal (as defined in this report) would imply, if used here, that all of these reserves would be used to make high-temperature coke.

** See Appendix A, p. 29, below.

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These limitations are particularly applicable in the Donbas, where the coal deposits occur in thin seams at great depths. The following factors, however, have made and will continue to make the Donbas the principal supplier of coking coals: the availability of the various types of coking coals in complementary proportions, the availability of iron and manganese ores, and the general industrial attributes of the basin.

Mining in the Kuzbas is somewhat simpler than in the Donbas because deposits in the Kuzbas are much thicker and lie much nearer the surface. Although total reserves of coals with coking characteristics in the Kuzbas are about five times as large as those in the Donbas, reserves of the more desirable types represent a much smaller portion of the total for the basin. Furthermore, because of the complicated geologic structure of a large part of the basin, future mining at deeper levels will serve only to maintain the output of coking coals near current levels.

Rapid exploitation of the Karaganda Basin deposits of coals with coking characteristics has been planned for many years. Goals for gradually replacing Kuzbas coals with Karaganda Basin coals at the metallurgical plants of the Urals and for the creation of coke-chemical industries in Kazakhstan based on regional coal would require quadrupling the present production capacity of the Karaganda Basin. Although reserves are adequate, the realization of these goals will be possible only over an extended period of time because of the large construction program and capital investment required.

Reserves of coal in the Kizel Basin are large but of a type that is generally used only in small proportions in coking-coal blends.

Some of the largest reserves of coals with coking characteristics are in the Pechora Basin near Vorkuta. Their development is limited currently by the availability of only the "fatter" types of coals, mining capacity, and lack of nearby markets. These coals were to have been used at a metallurgical combine at Leningrad, which was to have been constructed at the close of World War II. 10/ It is probable that the lack of certain complementary types of coal has been partly responsible for the delay in the construction or operation of the combine.

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Total Soviet reserves of coals with coking characteristics are vast. They are mostly in the Asiatic area of the USSR and are predominantly Type G (gas) coals. 11/ In general, their distance from deposits of iron ore or existing metallurgical plants and their type and quality limit their use for coking.

There is no available information on the number of new mines planned for the sole or primary purpose of expanding the coking-coal base. It seems reasonable to assume, however, that the majority of the 325 mines with a capacity of 115.3 million tons provided for in the Fourth Five Year Plan (1946-50) were planned for the production of coking coals. Likewise, it is believed that coking coals represented a large portion of the capacity increase of 30 percent planned under the Fifth Five Year Plan. Large sums for capital investment were provided to the Ukrainian coal industry in 1955 to build 45 new mines and to modernize 40 mines. 12/ Because of the difficult construction problems of the new deep mines in the Donbas, it is not surprising that, as of 6 March 1955, construction plans were not being fulfilled. 13/

To summarize, the deposits of coals with coking characteristics are abundant in all producing basins, but the mining of them is becoming more costly, and their quality is poor. Larger investment for mining coking coals and improved technology of mining, preparation, and coking will be required to maintain the current coking-coal base, and an even greater effort will be necessary to expand the base.

B. Production.

In Soviet plan announcements the production of coking coals is usually mentioned separately from total production goals, and the goal for coking coals always requires a higher rate of increase in production than does the goal for total coal. In the Fifth Five Year Plan, for example, total coal production is to be increased 43 percent over 1950, but production of coking coals is to be increased 50 percent over 1950. Furthermore, the production of coking coals is given equal priority with nonferrous metals and other strategic raw materials. It is significant that in the announcement of production achievements, production of coking coals is given individual attention.

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Despite the availability of deposits of relatively poor-grade* coking coals and the technical and economic problems inherent in their mining, the production of these coals in the USSR continues to rise and at present is at an alltime high.

Coking coals have been produced primarily from four basins: the Donbas, the Kuzbas, the Karaganda Basin, and the Kizel Basin. 14/ During 1954, production of coking coals began on a small scale in the Tkvarcheli and Tkvibuli deposits in the Georgian SSR. 15/ There is believed to be some production in other fields but generally on such a small scale that it does not appear separately in any statistical data.

The latest absolute figures published by the USSR on the production of coking coals are for 1940. 16/ Recent publications give the percent of total coal production of each basin used for coking coal in 1940 and 1952. 17/

The estimated production of coking coals in the USSR, by basin, in 1940 and 1950-54 is shown in Table 1.

Table 1

Estimated Production of Coking Coals in the USSR, by Basin a/
1940 and 1950-54

Million Metric Tons

	Basin					
Year	Donbas	Kuzbas	Karaganda	Kizel	Other	Total
1940	22.8	5.8	0.9	0.6	0	30.1
1950	24.5	13.6	2.3	2.1	0	42.5
1951	26.5	14.7	2.5	2.2	0	45.9
1952	27.8	15.7	2.7	2.3	0.1	48.6
1953	29.5	16.6	2.9	2.4	0.1	51.5
1954	31.0	18.1	3.2	2.5	0.3	55.1

a. Data for 1940 [redacted] Data for 1950-54 are calculated from percentages of total basin production given for 1952 [redacted] Data for 1952-54 for other basins are estimated [redacted]

50X1
50X1
50X1

* By Western standards.

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The Donbas, producing an estimated 31 million tons of coking coals in 1954, remains the principal supplier in the USSR. Thus, following an almost complete shutdown of the mines in this basin during World War II, the Donbas was exceeding its prewar production by 1950, and it is estimated that in 1954 the production of coking coals in this basin was about 36 percent higher than in 1940. This would have required large investments and heavy inputs of labor and material.

In terms of tonnage the production of Kuzbas coking coals has risen more rapidly than that of any of the other coking-coal basins. The Kuzbas mines produced about 18.1 million tons of coking coals in 1954, 12 million tons more than in 1940. In this same period the Donbas increased its production of these coals by about 8 million tons. In 1954 the Kuzbas accounted for about 33 percent of Soviet production of coking coal, as compared with 19 percent in 1940.

Although the Donbas and the Kuzbas together produced about 90 percent of Soviet coking coals, the Karaganda Basin and the Kizel Basin are currently producing significant quantities. Each of these basins produced about 3 million tons of coking coals in 1954, as compared with a production of less than 1 million tons each in 1940.

The only other area for which production of coking coals has been announced is the Georgian SSR. The announcement stated that, for the first time, coal from the Tkvarcheli and Tkvibuli deposits, in the amount of hundreds of thousands of tons, was shipped to the Krivoy Rog plant for coking. 21/

Production data for the various types of coking coals in the Donbas show a regular rise in the production and consumption of Type G (gas) coals. The increase in the use of these relatively poor coking coals from 7.6 percent of all coking coals in the Donbas in 1940 22/ to 14 percent in 1952 23/ illustrates that the USSR has overcome some of the difficult technological problems involved in adapting these poorer coking coals for use in relatively larger proportions. It also indicates a continuing deterioration in the coking-coal mixtures and thus a less satisfactory coke.

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Approximately one-third of the production of Donbas coals with coking characteristics is not used for coking. 24/ This includes coals which cannot be cleaned to coking specifications and types of coals for which suitable complementary coking types are not available.

Long-range production goals for coking coals have not been met. In fact, the 1941 and 1950 plans for 65.7 million and 57.7 million tons, respectively, were established at levels much higher than production rates during the years immediately preceding the announcement of the respective plans would warrant. At the 1953-54 rate of increase the production of coking coals in 1955 would be about 59 million tons, nearly 5 million tons less than the original 1955 goal (estimated to be 63.8 million tons). Substantially higher rates of increase are indicated during the first quarter of 1955, however, and if continued throughout the year, these rates of increase would provide from 62 million to 64 million tons of coking coal. A planned increase of 13 percent in 1955 over 1954 in production of total coals in the USSR indicates a new over-all coal production goal. 25/ There is some doubt, however, that the original coking-coal goal has been revised; a 15-percent increase in the production of coking coals would be necessary to achieve the original goal. It is believed that the USSR will fall slightly short of this original goal.

Planned production of coking coals in the USSR, by basin, in 1950 and 1955 is shown in Table 2.*

C. Quality Control.

In all probability the quality of coking coals is the most limiting factor in the coking-coal base in the USSR. Both the ability of a coal to coke and the quality of the coke are determined by the chemical and physical properties of the coal. The general lack of types of coals with the optimum of such properties requires the blending of several types having somewhat inferior properties. These latter types can be blended, however, only if their properties are complementary.

* Table 2 follows on p. 13.

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Table 2

Planned Production of Coking Coals in the USSR, by Basin
1950 and 1955

	Million Metric Tons	
Basin	1950 Goal a/	Original 1955 Goal b/
Donbas	33.8	N.A.
Kuzbas	17.5	N.A.
Karaganda	3.9	3.5 c/
Kizel	2.2	N.A.
Other	0.3	N.A.
Total	57.7	63.8

a. Total from Fourth Five Year Plan. [redacted] 50X1
[redacted] 50X1

b. An increase of 50 percent over 1950 production. 27/
c. An increase of 54 percent over 1950 production. 28/

Coals with complementary properties are produced in the Donbas, and the problem of blending is an intrabasin one. The same is true of the Kuzbas. Because only small amounts of poor-coking types of local coals are available at plants in the Urals, this area is dependent on the Kuzbas and the Karaganda Basin for the better types of coking coals. Furthermore, the relatively poor coking properties of Kizel coals require a higher percentage (80 percent) of the K (coking) and PZh (steam, fat) coals in coking coal blends at plants in the Urals than at plants in the Kuzbas (60 percent) and the Donbas (68.3 percent). 29/

Impurities in many Soviet coals with good coking characteristics limit and often prohibit their use alone or in blends for coking. Donbas coking coals, as mined, are high in ash (3 to 30 percent, averaging

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16.4 percent in 1951) and high in sulfur content (1.5 to 4.5 percent, averaging 2.8 percent in 1951). Kuzbas coking coals, as mined, are relatively low in ash (4 to 18 percent, averaging more than 13 percent in 1951) and very low in sulfur (0.3 to 1.0 percent). 30/ Karaganda Basin coking coals, as mined, are very high in ash (12 to 37 percent) but very low in sulfur (0.5 to 1.2 percent). Kizel Basin coking coals, as mined, are very high both in ash (15 to 30 percent) and in sulfur (3.2 to 4.2 percent). 31/

Ash specifications for blast-furnace coke are 9.7 percent ash in Donbas coke and 11.2 percent ash in Kuzbas coke. 32/ All of the ash in a coal remains in the coke. Assuming an average coke yield of 70 percent, 33/ the average ash content for coals from the Donbas and Kuzbas should be 6.8 and 7.8 percent, respectively. Comparing these averages with those in the preceding paragraph, it is obvious that many of these coals cannot be used to make blast-furnace coke and that most of those that can be so used must be subjected to thorough mechanical cleaning.

It is estimated that in 1954 over 95 percent of the coking coals in the USSR were mechanically cleaned.* Despite an increasing impurity content of run-of-mine coking coals in postwar years, the USSR generally has succeeded in obtaining a cleaned product low in ash and only slightly higher in sulfur content then it was in prewar years. 34/ In achieving low levels of impurity content, cleaning losses increase greatly. At the Donbas cleaning plants, for example, cleaning losses increased from 14.2 percent of the run-of-mine coal in 1940 to 24.7 percent in 1951. In other words, 2-1/3 times as much coking coal had to be mined in 1951 as in 1940 to provide 2 times the amount of cleaned coal for coking. When it is considered that postwar mining in the USSR is more costly than mining was in 1940, the increased strain on the economy resulting from poorer quality run-of-mine coking coals is obvious.

Although the USSR has been quite successful in cleaning coking coals, available data** show that most Soviet cokes do not meet quality specifications and that they are generally inferior

* See Appendix B, Table 7, p. 33, below.
** See Appendix C, Table 8, p. 35, below.

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to cokes made in other countries. This indicates that the average blast furnace in the USSR operates at a lower capacity and with higher unit inputs of raw materials than is indicated by the ash specifications or than does the average furnace in other countries. In addition, the quality of the pig iron from the Donbas blast furnaces probably is below specifications because of the high sulfur content of the coke.

D. Consumption and Distribution.

1. Consumption by Plants.

Disregarding foreign trade and changes in stocks (both of which are small), the data on the production of coking coal shown in Table 1* represent roughly the tonnage of the coals consumed. All of the southern coke plants, and probably the northern plants in the European USSR, depend on the Donbas for their supply of coking coals. The coke plants in the Urals, on the other hand, use all of the Kizel Basin coking coals, 35/ probably all of the Karaganda Basin coking coals, and 62 to 63 percent of the Kuzbas coking coals. 36/ The smaller plants in isolated areas, such as Suchan, generally use local coking coals.

The types and blends of coking coals are determined by the use for which the coke is made and by the availability of coals with complementary coking properties and the proper coking characteristics.

High-temperature coke is used for many purposes. It is estimated that about 90 percent of the total is consumed by ferrous metallurgy -- 75 percent of the total for making pig iron in blast furnaces. Other ferrous metallurgical uses are in foundry cupolas, forges, gas generators, and heating. Other consumers of high-temperature coke are machine-building foundries (about 5 percent of the total production of coke), chemical plants (about 3 percent), and nonferrous metallurgy (about 1 percent), the remainder being consumed by rail and water transport and for other minor uses. 37/

The estimated consumption of coking coals in the USSR, by plant and by economic region, in 1954 is shown in Table 3.**

* P. 10, above.

** Table 3 follows on p. 16. (Text continued on p. 19.)

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Table 3

Estimated Consumption of Coking Coals in the USSR, by Plant and by Economic Region a/*
1954
(Continued)

Million Metric Tons

Economic Region and Plant Name	Location	Amount
Region V e/		
Metallurgical Plant imeni Stalin	Rustavi	f/
Region VII g/		
Moscow Coke Gas Plant	Moscow	0.3
Total region		0.3
Region VIII h/		
Metallurgical Plant imeni Bakal	Chelyabinsk	2.5
Novo Tagil Metallurgical Plant	Nizhniy Tagil	3.6
Metallurgical Combine imeni Stalin	Magnitogorsk	5.6
Gubakha Coke Chemical Plant	Gubakha	1.3
Novo-Troitsk Metallurgical Plant	Novo-Troitsk	0.7
Unallocated d/		3.3
Total region		17.0
Region IX i/		
Kuznetsk Metallurgical Plant	Stalinsk	3.3
Kemerovo Coke Chemical Plant	Kemerovo	2.9
Unallocated d/		0.6
Total region		6.8
Region XI j/		
Noril'sk Coke Chemical Plant	Noril'sk	0.2
Total region		0.2
Region XII k/		
Suchan Coke Plant	Suchan	f/
Total of all regions		55.1 l/

* Footnotes for Table 3 follow on p. 18.

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Table 3

Estimated Consumption of Coking Coals in the USSR, by Plant and by Economic Region a/
1954
(Continued)

a. No consumption is known at plants and in regions not shown. The term region in this report refers to the economic regions [redacted] 9-51 (First Revision, 7-52), USSR: Economic Regions.
b. 38/
c. Calculated at a 70-percent coke yield per plant. [redacted]
d. Unallocated includes unknown consumption at other plants, plant expansions, new plants, and production of high-temperature coke at gas plants.
e. 39/
f. Less than 50,000 tons.
g. 40/
h. 41/
i. 42/
j. 43/
k. 44/
l. Includes the tonnages of plants with less than 50,000 tons of coal consumption.

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The large tonnages in the "unallocated" category in Table 3 probably represent mostly unknown expanded capacity at known plants. This conclusion is supported by a published statement 45/ to the effect that during the Fifth Five Year Plan expansion of ferrous metallurgy in the principal metallurgical regions (South, Urals, and Siberia) will be accomplished by expanding existing combines and plants rather than by constructing new ones.

The estimated consumption of coking coals in the USSR, by economic region and by basin of origin, in 1954 is shown in Table 4.

Table 4

Estimated Consumption of Coking Coals in the USSR
by Economic Region and by Basin of Origin
1954

Million Metric Tons

	Basin of Origin					
Economic Region	Donbas	Kuzbas	Karaganda	Kizel	Other	Total
III	30.7	0	0	0	0	30.7
VII	0.3	0	0	0	0	0.3
VIII	0	11.3	3.2	2.5	0	17.0
IX	0	6.8	0	0	0	6.8
XI	0	0	0	0	0.2	0.2
Total	31.0	18.1	3.2	2.5	0.2	55.1 a/

a. Includes the tonnages of plants with less than 50,000 tons of coal consumption.

2. Distribution.

Table 4 shows that in 1954 about 11.3 million tons of Kuzbas coking coals and about 3.2 million tons of Karaganda Basin coking coals were shipped to the Urals. It also shows that about 300,000 tons were

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shipped from the Donbas to the Moscow area. Otherwise, coking coals were generally distributed to coke plants within the coal-producing areas. The estimated distribution of coking coals from the Asiatic USSR, by plant, in 1954 is shown in Table 5.

Table 5

Estimated Distribution of Coking Coals from the Asiatic USSR, by Plant 1954

Million Metric Tons

Basin of Origin	Destination	Amount
Kuzbas a/*	Coke plants in the Kuzbas	
	Kemerovo	2.9
	Kuznetsk	3.3
	Unallocated	0.6
	Total	6.8
Kuzbas a/	Coke plants in the Urals	
	Magnitogorsk b/	3.6
	Gubakha c/	0.2
	Chelyabinsk, Novo-Tagil'skaya, Novo-Troitsk, Unallocated	7.5
	Total	11.3
	Total from the Kuzbas	18.1

* Footnotes for Table 5 follow on p. 21.

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Table 5

Estimated Distribution of Coking Coals from the Asiatic USSR, by Plant 1954 (Continued)

Million Metric Tons

Basin of Origin	Destination	Amount
Karaganda Basin	Coke plants in the Urals	
	Magnitogorsk b/	2.0
	Novo-Troitsk)	1.2
	Others)	
	Total from the Karaganda Basin	3.2
Kizel Basin	Coke plants in the Urals	
	Gubakha c/	1.1
	Chelyabinsk)	1.4
	Novo-Tagil'skaya)	
	Total from the Kizel Basin	2.5
Noril'sk	Noril'sk Coke Plant	0.2
	Total from Noril'sk	0.2
	Grand total	24.0

a. Coking coals from the Kuzbas were distributed as follows: 37.5 percent to Kuzbas plants and 62.5 percent to Urals plants. 46/

b. Of the coals used for coking by the Magnitogorsk plant, 65 percent are from the Kuzbas and 35 percent are from the Karaganda Basin. 47/

c. The coking-coal blend at the Gubakha plant contains 82.5 percent Kizel Basin coking coals and 17.5 percent Kuzbas coking coals. 48/

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In the transportation of Karaganda Basin and Kuzbas coking coals over distances of approximately 1,200 and 2,000 kilometers, respectively, careful scheduling of deliveries of the proper coals to each of the Urals plants is of great economic importance. At a rail freight rate for coal and coke of 3.72 kopecks per ton-kilometer, 49/ the unit cost of transporting Karaganda Basin coking coals to the Urals is approximately 45 rubles and of Kuzbas coking coals, about 74 rubles. Depending on the type of coking coal, this cost represents about 35 to 38 percent of the delivered price of Karaganda Basin coals and about 45 to 48 percent of the delivered price of Kuzbas coking coals.

Forty days before the beginning of a quarter, Glavuglesbyt (Glavnoye Upravleniye po Sbytu Kamennougol'nogo Topliva -- Main Administration for the Marketing of Coal Fuel) usually submits through a subsidiary, Kuzbasuglesbyt (Kuzbas Upravleniye po Sbytu Kamennougol'nogo Topliva -- Kuzbas Administration for the Marketing of Coal Fuel), for example, to Glavkoks (Glavnoye Upravleniye Koksokhinicheskoy Promyshlennosti -- Main Administration of the Byproduct Coke Industry) its plan for all types of coal output from each mine. Glavkoks establishes the daily obligation of the Kuzbasuglesbyt to issue fuel, including the mine from which the fuel is to come, the plant to which it is to go, and the amount which is to be shipped. 50/

A typical delivery and scheduling problem concerns the supply of Kuzbas coal sent to Magnitogorsk. It was claimed that in 1950 and the early part of 1951 the Kuzbas Coal Combine failed to deliver the required types of coking coals, although the over-all shipping plan was fulfilled. Glavkoks was criticized by the Minister of the Coal Industry for planning mine and plant coking-coal mixtures without calculating the necessary conditions for routing the coal shipped. An agreement was reached with the Minister of Ferrous Metallurgy, which provided for changes in the coking charge, making possible the routing of Kuzbas coking coal to Magnitogorsk with the least deviation. 51/

Two postwar railroad construction projects directly affect the expansion of the raw-material base for coking coals. The construction of a 550-kilometer link from Pavlodar to Akmolinsk completes the South Siberian Railroad and establishes a direct connection between Magnitogorsk and Stalinsk. 52/ The development of new mines and a

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new mining town, Tomusinsk 53/, indicates the completion or near completion of the western part of the proposed 378-kilometer railroad from Stalinsk to Abakan. In addition to serving the largest coking coal field developed since World War II, this railroad will provide a direct link between the iron ore deposits near Abakan and the center of the Kuzbas metallurgical industry.

3. Production of High-Temperature Coke.

High-temperature coke is produced primarily in byproduct slot-type ovens at temperatures above 900°C. In addition, a small amount is produced in beehive ovens. Most of this high-temperature coke is for metallurgical use. The estimated production of high-temperature coke in the USSR in 1940 and 1950-54 is shown in Table 6.

Table 6

Estimated Production of High-Temperature Coke in the USSR
1940 and 1950-54

Million Metric Tons

Year	Amount
1940	20.9 a/
1950	25.8 b/
1951	29.4 b/
1952	33.5 b/
1953	36.6 b/
1954	39.7 b/

a. The 1950 plan of 30 million tons is 143.8 percent of 1940 production. 54/
b. Based on an estimated use of 75 percent of total high-temperature coke in blast furnaces for the production of pig iron 55/ and a pig iron-to-coke ratio of 1:1.

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E. Stocks. 56/

On 1 January 1955, coke plants in the south had a 4-day supply of coking coals in stocks, compared with a norm for this area of 8.6 days. At the same time, coke plants in the east had a 6.6-day supply, compared with a norm of 15.2 days. If it is assumed that the norm for stocks of coke plants with nearby sources of supply is the same as for plants of the south, the Urals plants would have a norm of about 22 days' supply of Kuzbas and Karaganda coals.

Stocks of coking coals in the USSR were drastically reduced during the last half of 1954 and the first quarter of 1955 because of undershipment to the coke plants.

Soviet stocks and stock norms for coking coals are considerably lower than those of the US. On 1 January 1955, average stocks at US coke plants were 48 days' supply. A 30-day supply is the minimum desired by most US coke plants, and at the beginning of winter some remote plants accumulate a 4- to 5-month supply. 57/

F. Foreign Trade.

Foreign trade in Soviet coking coals is very small. Exports have gone to Japan and Rumania, and an agreement to export coking coals to Finland has been concluded. It is possible that some of the coals imported from Poland are used at coke plants in the western part of the USSR.

Exports of 100,923 tons of coking coals in 1953 from Sakhalin mines to Japan were reported. 58/ Because of the poor quality of the 1953 deliveries, however, exports of only about 68,000 tons were agreed upon for 1954. 59/ There is no record, however, of the amounts actually shipped. It is estimated that the annual requirements of Rumania amount to about 250,000 tons of coking coals. 60/ It is estimated, therefore, that total Soviet exports of coking coals in 1954 were almost 350,000 tons. An agreement between the USSR and Finland provides for the export of 50,000 tons of coking coals annually for 1956-60. 61/

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The USSR may be planning for increased exports of coking coals in the future. These would be to Satellite countries where coking coals are extremely scarce, and where new coke-oven plants are under construction or are planned.

G. Prices.

Available information indicates that Soviet coal prices, f.o.b. station of shipment, are established for individual types and sizes of coal without considering the ultimate use of the coal. 62/ Nevertheless, each price apparently is determined on the basis of quality and cost of production. Accordingly, coking coals, because of their better quality and higher costs of production, are the highest, or among the highest, priced coals in their respective basins. Price differentials between any two basins for a particular type of coal are believed to represent the approximate relationship in costs of production between the two basins.

Current prices for Soviet coking coals are not available. Wholesale prices for all types of coals, including types used for coking, were established on 1 January 1950. 63/ For each price an ash norm was established. For each percent of ash content above or below the norm, a price deduction or increase of 3 percent of the wholesale price of that type or grade of coal is made. Thus, although the price list may be effective currently, selling prices fluctuate and can be determined only when ash content data are available.

H. Expansion of the Coking-Coal Base.

The USSR can be assumed to have adequate reserves of coals which can be used for coking if the coal is cleaned, if the different types have complementary properties, and if the types are available in the proper proportions for coking.

The capacity to produce these coals will be limited only by capital investments for new and expanded mines. Because of the importance of these premium coals to the economy of the country, there is no doubt that such investments will be made. The improvement in the quality of cleaned coals during recent years, in spite of the delivery of increasing quantities of poor-grade run-of-mine coals to cleaning plants, indicates the ability of the USSR to cope with cleaning requirements.

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The availability at individual plants of the different types of coking coals with complementary properties and in the proper proportions represents the most significant obstacle to the expansion of the coking-coal base.

The USSR has experimented considerably in the use of combinations of various types of coal for coking. The Donbas contains large reserves of Type G (gas) coals, and although their use has increased rapidly since 1940, they must be used in even greater amounts to meet the expanding needs. Likewise, Type T (lean, noncaking) and Type D (long-flame) coals must be further utilized if possible. About one-half of all explored Type G (gas) coals and nearly three-fourths of all Type T (lean, noncaking) coals have a low sulfur content, while only one-third of Types K (coking), PZh (steam, fat), and PS (steam, caking) coals, the types most widely used in coking, have a low sulfur content. 64/ Success has been claimed with coal charges containing as much as 40 percent Type G (gas) coals, but experiments generally indicate limits of 20 to 30 percent of these coals, depending on the other coals in the coking charge. The use of Type G (gas) coals tends to lower the unit yield of coke and also may result in relatively low-strength coke. Widespread use of G (gas) coals, however, seems imperative. Tests with Type T (lean, noncaking) and Type D (long-flame) coals have met with some success, but their use is limited to a small portion of the charge, and they must be finely ground for adequate blending with the rest of the charge. 65/

Many modifications of coking-coal charges are currently being tested at Soviet coke plants, and developments may provide the chief avenue of expansion of the coking-coal base in the future by permitting the use of poorer coals in increasing amounts.

Several substitute fuels have been tested, but their application is so limited and so costly that their influence on improving the general coke supply has been negligible. Chief among these are lignite coke, or brown-coal coke. Although it is not known whether the USSR actually has used these cokes, experience in other countries indicates very limited use of them. Other substitutes tested are heat-treated, high-volatile coal 66/ and other solid fuels, which are charged directly into the blast furnaces -- charcoal, 67/ peat briquettes, 68/ peat coke, 69/ peat semicoke, 70/ SS (weakly caking) coals (from the Kuzbas), 71/ and lignite-charcoal-tar briquettes. 72/

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III. Other Coking Coals.

Other coking coals are coals used in medium-temperature and low-temperature (or semicoking) processes. In both processes, coke is made as a secondary product. The two processes differ not only in temperature factors but also, in general, in the content of raw material being used.

Bituminous coal, preferably with a high volatile-matter content, such as Type G (gas) and Type D (long-flame) coals serve as raw material for medium-temperature coking. The tar from this process contains a considerable amount of phenol, and the gasoline-benzene fraction is a high-grade motor fuel. 73/ Type G (gas) and Type D (long-flame) coals are used for many other purposes, including high-temperature coking, and reserves are adequate. The tonnages of these coals consumed in medium-temperature coking are unknown but are believed to be negligible.

A great variety of solid fuels is used in semicoking (low-temperature coking). These include noncoking bituminous coals (usually of sub-bituminous rank), lignite, and peat. The main purpose of semicoking is to obtain primary tar and gases which are used in the production of synthetic liquid fuel. The semicoke produced may be used as a smokeless fuel (burned in the boilers of electric power stations) or for gas production. 74/

The estimated consumption* of coal used for semicoking at liquid fuels plants in the USSR in 1953-55 is shown in the following tabulation 76/ (in million metric tons):

Year	Amount
1953	0.5
1954	1.5**
1955	4.9

* Estimated on the basis of 10 tons of coal per ton of liquid fuel.

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** Includes 1.2 million tons of Cheremkhovo coal, 0.1 million tons of Kuzbas coal, and 0.2 million tons of Sakhalin coal.

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IV. Capabilities, Vulnerabilities, and Intentions.

A. Capabilities.

It is estimated that the original Soviet 1955 goal for coking coals, approximately 64 million tons, will almost be met.

It should be noted that the production of coking coals failed to meet the 1950 goal by 27 percent. Although current planning may be more realistic, the 45- to 50-percent increase in production of coking coals between 1950 and 1955 is significant.

B. Vulnerabilities.

Because of the long railroad hauls required, the transportation of Kuzbas and Karaganda Basin coking coals to plants in the Urals is the chief vulnerability. Imports of coking coals are very small, and curtailment of imports would not have a major effect on the industry.

C. Intentions.

Planned increases in production of coking coals are almost directly related to production plans for iron and steel. There is no indication of warlike intentions in the plans, except as increases in the output of these materials add to the military potential of the USSR. Because coking coals deteriorate in storage, advance warning of military intentions by the stockpiling of these coals is not likely.

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APPENDIX A

RESERVES AND DEPOSITS OF COKING COALS IN THE USSR

I. Reserves.

Quantitative data on reserves of coals with coking characteristics are available only for the Donbas and the Kuzbas, as follows:

	Donbas		Kuzbas	
Type of Coal	Percent of Basin*	Amount** (Billion Metric Tons)	Percent of Basin*	Amount*** (Billion Metric Tons)
G (gas)	19.0	16.6	35.0	157.9
PZh (steam, fat)	12.6	11.2	3.8	17.1
K (coking)	5.0	4.5	2.5	11.3
PS (steam, caking)	8.8	7.8	5.0	22.6
Total	45.4	40.4	46.3	208.9

Total coal reserves of the Karaganda Basin are estimated to be 53 billion tons. 80/ Estimates of each type of coal with coking characteristics are not available, except that reserves of Type PZh (steam, fat) and Type K (coking) are more limited than those of Type PS (steam, caking). 81/

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* 77/

** Percentages were applied to the total Donbas coal reserves of 88.9 billion tons. 78/

*** Percentages were applied to the total Kuzbas coal reserves of 451 billion tons. 79/

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The reserves of Kizel Basin coals are estimated to be 3.4 billion tons and to be largely Type G (gas) and a small portion of Type PZh (steam, fat). 82/

Quantitative data on reserves of coals with coking characteristics in other basins and fields are not available. It is known, however, that the total reserves of coals with coking characteristics are vast, are predominantly in the Asiatic part of the USSR, and are mostly Type G (gas) coals. 83/

II. Deposits.

A. Donbas.

Deposits of coals with coking characteristics generally lie in the southwestern section of the Donbas. 84/ Approximately 40 seams of such coal are mined for coking. 85/ These seams are mined at various levels, the deepest to date being worked at levels about 1,000 meters below the surface. 86/ These coking-coal seams average less than 1 meter in thickness, most of them being about one-half of a meter thick. They are steeply pitching and most of them contain a number of rock partings.

The rapid exhaustion of Donbas deposits found at levels less than 1,000 meters from the surface has made it necessary to plan new mines at deeper levels. Where the seams are steeply pitching, the lower limits will be at depths of about 2,000 meters. A new coking-coal mine is being developed at Gorlovka with a proposed depth of 1,560 meters. 87/ The mining of deposits at depths below 1,000 meters creates the following problems 88/:

1. Gaseous conditions increase almost in proportion to the increased depth of mining. Even at levels nearer the surface, gaseous conditions have been serious in Donbas mines.

2. The temperature increases with the depth. Temperature estimates averaging 30°C (86°F) have been made for 1,000-meter levels. Actual measurements showed 54°C (129°F) at a level 1,450 meters below the surface.

3. Water must be pumped at much higher pressures.

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4. Roof pressure increases directly with the depth of the seam.

5. Haulage of coal, mining supplies, and mining becomes more difficult and costly at lower levels.

B. Kuzbas.

The coking-coal deposits of the Kuzbas are much thicker and are mined nearer the surface than those in the Donbas. In underground operations the seams are mined at depths of 100 and 200 meters, an average level of 150 meters below the surface. In the extreme southern part of the basin the seams are nearer the surface and are strip-mined. The seams attain a thickness of 12 to 14 meters and average 4 meters. 89/

The highest grade of coking coals in the Kuzbas, and probably in the entire USSR, is found in the Prokop'yevsk-Kiselevsk region of the basin. The easily accessible upper coal beds of this basin are already well exploited. Hence the best prospects of the area for the future mining of coking coal are in the deep levels of the mines. Because of the complicated geologic structure of the region and the very steep pitch of the seams, however, the deep levels will serve only as a base for maintaining the output of coking coal at current levels. 90/

The advantages of the Kuzbas coals -- abundant reserves of high-quality coal in thick seams occurring relatively near the surface -- are offset to some extent by the following disadvantages:

1. The quality of the coal from the same seam is not uniform, and quality varies particularly between seams. Although the average quality may be good, the lack of uniformity is sometimes considered to be more serious for coking purposes than a poorer quality coal.

2. The coal seams lie in steeply pitching positions, sometimes nearly vertical, making mining conditions difficult and hazardous.

3. The coal seams are susceptible to spontaneous combustion, and fires have seriously hampered operations at many mines.

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Kuzbas coking coals are also produced (1) in the Kemerovo region, (2) in the Anzhero-Sudzhensk region, (3) in the Tomusinsk region, (4) in the Leninsk-Kuznetsk region, (5) in the Prokop'yevsk-Kiselevsk region, and (6) in the Osinniki region.

C. Karaganda Basin.

Coking coals occur in the southern part of the Karaganda Basin. Moreover, the Churnbay-Nura district, in the western and northwestern portion of the basin, is to become a very prominent source of coking coal. Seams in the basin vary in thickness from 0.8 to 8.3 meters. The Karaganda coals are high in ash and low in sulfur content. All coking coals must be cleaned.

D. Kizel Basin. 91/

The Kizel Basin lies on the western slope of the Urals. The Kizel Basin is the only field in the Urals in which coking coals are produced. The Kizel coals are characterized by a high ash and sulfur content, but after thorough cleaning, they can be used for coking in mixtures with Kuzbas coals. The coal seams are irregular in many respects. They are noncontinuous, they may contain many or no rock partings, they vary in thickness and they have numerous folds and faults. The number of workable seams varies from 1 to 5, and the thickness varies from 0.5 to 2 meters, occasionally reaching 5 to 7 meters.

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APPENDIX B

MECHANICALLY CLEANED COAL USED FOR COKING IN THE USSR 1940 AND 1950-54

Table 7

Million Metric Tons

Year	Basin					
	Donbas	Kuzbas	Karaganda [a]	Kizel [a]	Other [a]	Total
1940	18.2 [b]	0.0 [b]	0.9	0.6	0.0	19.7
1950	23.0 [c]	6.6 [d]	2.3	2.1	0.0	34.0 [e]
1951	25.1 [f]	10.4 [d]	2.5	2.2	0.0	40.2 [g]
1952	26.4 [h]	14.9 [h]	2.7	2.3	0.1 [i]	46.4
1953	28.0 [h]	15.8 [h]	2.9	2.4	0.1 [j]	49.2
1954	29.5 [h]	17.2 [h]	3.2	2.5	0.3	52.7

a. It is assumed that the total production of coking coals was cleaned.
b. Equivalent to 80 percent of the Donbas coking coals and none of the Kuzbas coking coals. 92/
c. Assumed to be 94 percent of the total Donbas production of coking coals.
d. Residual.
e. Equivalent to 80 percent of the total coking coals. 93/
f. Equivalent to 94.6 percent of the Donbas production of coking coals. 94/
g. Interpolated.
h. Assumed to be 95 percent of the total coking coals in the Donbas and the Kuzbas. 95/
i. The Noril'sk cleaning plant was completed in the latter part of 1951. 96/
j. In addition to the Noril'sk plant, the Tkvarcheli and Tkvibuli plants began cleaning coals in 1953. 97/

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APPENDIX C

COMPARISON OF ASH AND SULFUR CONTENT OF COKE MADE FROM SELECTED SOVIET AND NON-SOVIET COALS a/

Table 8

Percent

Source of coal	Ash	Sulfur
Donbas	14.6	2.3
Donbas	16.0	1:2
Donbas	10.3	1.5
Donbas	9.5	1.3
Kuzbas	12.4	0.4
Kuzbas (blend of Prokop'yevsk and Osinniki coals)	13.6	0.5
Kuzbas (blend of Prokop'yevsk and Leninsk coals)	13.5	0.6
Blend of Kuzbas and Karaganda coals	13.4	0.6
Karaganda	15.6	1.1
Blend of Kuzbas (Prokop'yevsk) and Kizel Basin Coals	16.1	1.4
Blend of Karaganda and Kizel Basin Coals	16.2	1.7
Durham, England	8.4	1.0
Ruhr, West Germany	10.2	2.0
Silesia, Poland	10.0	1.0
Connellsville, US	10.6	0.9

a. 98/. Believed to be on an "as received" basis.

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